ISSN 2411-7323

Int Journal of Social Sciences Management and Entrepreneurship 1(1): 97 -112, April 2017
 www.sagepublishers.com

DETERMINANTS OF SUSTAINABILITY OF E-WASTE MANAGEMENT PROJECTS BY NAIROBI COUNTY GOVERNMENT

ODERO JOHN OHAGAH[1], DR WERE SUSAN [2]

[1, 2] Jomo Kenyatta University of Science and Technology

Abstract

Old appliances which have reached their end-of-life may not be very useful to their owners; however, they still need to be disposed properly. E-waste has been put on the priority waste streams list and is among the fastest growing waste streams (EEB, 2001). Managing e-waste encompasses not just the disposal or recycling, but also the pre-disposal logistics involved in collecting and transporting the waste. It also includes strategies for reducing the total waste generated, in line with the 4R principle - 'Reduce, Recover, Reuse and Recycle'. This study sought to establish the determinants of sustainability of e-waste by Nairobi County Government by reviewing recycling training, regulations, technology and analysing the rationale for trans-boundary movement of E-waste. The study adopted a descriptive research design with a target population of 325 employees of the department of waste management at Nairobi County Government at various departmental levels. The sample size was 99 respondents which is 30% of the target population. The sampling technique to be employed was stratified random sampling. This is because the respondents were stratified into three categories that is, departmental heads, supervisors and the support staff. The study collected both primary and secondary data. Data was analysed and presented using percentages and frequency tables. The tool of analysis was the regression analysis, measures of central tendency and the chi-square. The study found a significant relationship between regulations, recycling and disposal training, technology, trans-boundary movement and sustainability of E-waste management projects. The study concludes that regulations would lead to an increase in sustainability of E-waste management projects, recycling and disposal training would lead to an increase in sustainability of E-waste management projects, technology would lead to an increase in sustainability of E-waste management projects and trans-boundary movement would lead to an increase in sustainability of E-waste management projects. The study recommends that the government should put forth regulations that promote E-waste management. The government should encourage recycling and disposal training to educate people on issues to do with waste management. The waste management institutions should change their activities with the changing technologies. There should be the development of an international convention dealing specifically with waste management.

Keyword: Consumers, End-of-life, E-waste, Distributors, Recyclers, Refurbisher, Importers, Collectors and Trans-boundary movement.

Introduction

Waste refers to anything that is no longer privately valued by its owner or has reached its end-of-life (Porter, 2002). 'Electronic Waste', or e-waste, is therefore an end-of life electronic product that has ceased to be of any value for its owner. Electronic waste is one of the new challenges the information society must face. This challenge arises from the millions of pieces of equipment whose obsolescence, owing to the toxicity of their components, calls for special treatment for the protection of human health as well as the environment. There are also, in the electronic waste treatment process, business opportunities based on the recovery of valuable materials contained in the equipment. In industrialized countries, this issue has been included in national and regional agendas for some time, and there are currently strong measures and strategies which regulate the negative impact of electronic waste (Porter, 2002). According to Schmidt (2002), nine out of every ten homes possess an obsolete electronic device such as an outdated computer, a refrigerator or a mobile phone. It is probably covered in dust, lying at the base of your cabinet or trash can and grimy from lack of use. Obsolete electronic devices or electronic waste (also referred to as e-waste) are becoming common sites everywhere, giving birth to what some experts are predicting to be the largest toxic waste problem of the 21st century (Schmidt, 2002).

Over the past decade, the world has witnessed a significant increase in technology, especially in the area of communication. Computers are now created with DNA chips, giving them a close representation of human attributes, mobile phones now exhibit such similar traits as well, multi-touch features, body sensors, voice sensors, and even predictive thinking (Mauk & Metz, 2011). Between 2000 and 2005, the Organization of Economic and Cooperative Development (OECD) noted a 22% growth in Information and Communication Technology (ICT) in China. Amongst US, Japan, Germany, UK and France, China was rated as the 6th largest ICT market in 2006. This growth rate is interesting considering that less than 1% of China's population possessed a computer ten years ago (StEP, 2011). A look at the Waste Electrical and Electronic Equipment (WEEE) Directive (EU, 2010) revealed that rapid product innovations and its replacement, (especially in ICT and office equipment) in addition to the migration from analogue to digital technologies and to flat-screen TVs, monitors, compact and multi-tasking devices such as the iPad, iPhone and tablets, are fuelling the increase of electronic waste. The advent of lower prices for many electrical goods has caused an increase in global demand for many products that eventually end up as electronic waste. Computer devices constitute only a part of the electronic waste stream. As shown in United Nations University Review report of 2007, batteries, fridges and other cooling and freezing appliances, as well as household appliances, accounted for 44% of total e-waste (United Nations University (UNU), 2007).

As a result of this rapid and remarkable growth, e-waste or discarded electronic equipment is thus regarded as the fastest growing waste stream in the industrialized world. E-waste is a crisis born not only out of quantity generated but also from the cocktail of toxic ingredients. Substances such as lead, beryllium, flame retardants found in e-waste pose as both occupational and environmental health threat (Puckett, *et al.,* 2002). Industrialized and technologically advanced nations such as USA, the UK and other wealthy economies generate most of the world's electronic products and subsequently generate most of the e-waste. Rather than developing an ecological means of manufacturing and dealing with e-waste, these countries utilize another means of disposing their mounting collection of e-waste – exporting the e-waste to the developing countries especially Africa and Asia in the guise of 'second hand' electronics United Nations University (UNU), 2007).

Kenya, a country where this study is carried out, is home to over 42,000,000 people (KNBS 2010) with an increasing consumption of electronic gadgets such as mobile phones, electronic home and office appliances and auto-mobile electronic gadgets among others in all the 47 Counties. One of such County is Nairobi which is home to close to 4million people and also the capital city of Kenya. Kenya generates 14,400 tonnes from refrigerators, 2,800 tonnes from TVs, 2,500 tonnes from personal computers, 500 tonnes from printers and 150 tonnes from mobile phones (UNEP, 2010). The mass flow study carried out in 2007 by Kenya ICT Action Network showed that 1,513 tonnes of electronics entered the market. In addition the consumer also received 151.3 tonnes of electronic products from the second hand market. It was also revealed that consumers are likely to dispose 1,210.4 tonnes in the second-hard market, and 18.6 tonnes to collectors or as general waste which is sent to refurbishers. The consumer disposes a further 18.6 tonnes directly to recyclers. Refurbishers and recyclers then send 605.2 tonnes for disposal.

E-waste management has become a major problem not only in the Nairobi County Government, but also in most major cities in Kenya such as Mombasa and Kisumu. It is estimated that 18,000 tonnes of e-waste is generated annually in Kenya with Nairobi alone contributing 60% to 70%. Out of this, only 30% is collected for recycling, re-use and safe disposal owing to the fact that the county government has not established a comprehensive framework to manage e-waste (NEMA, 2015). 70% of these e-wastes is either lying in the homes of the owners or disposed incorrectly and poses a serious health and environmental hazard to the habitants of Nairobi County (NEMA, 2015). Although there have been initiatives by reputable firms to manage e-waste such Nokia through their recycling scheme and Computer for Schools through their refurbishment programme, the practices for managing e-waste are mostly handled by the informal sector (Jua Kali). Most of these operators have inadequate skills, are neither registered nor authorized and most of them operate in a secretive manner. These operations are well connected to the supply chain processes of sourcing the raw material to finding markets for the recovered materials during post-recycling operations. The processes are highly toxic and impact adversely to both the environment and human health. The lack of clear disposal mechanisms has resulted in excessive stocks being held by the consumer. The lack of well-developed structures to handle e-waste disposal cause a ‘drag’ on waste volumes (UNEP, 2010).

A lot of the old technology is held in storage due to a lack of clear strategies and processes for disposal. Disposal options vary widely depending on the user. Government ministries and departments have to bond the computers and invite competitive tenders for disposal as scrap in line with procurement procedures. The process is slow and results in obsolete computers being held in government stores. Private sector corporations such as CFSK and Nokia-Kenya, often donate the computers as charity to deserving users. Collectors, refurbishers and the recycling infrastructures are generally not developed and therefore the flow down the value chain has much lower volumes. For example, Safaricom Ltd initiated a take back scheme which failed because of location of collection centres and lack of awareness and incentives for consumers (NEMA, 2015). The ecological, economic and social consequences resulting from poor handling and management of e-waste include: Environmental consequences such as air pollution especially when e-waste is burnt, waste management problem of non-biodegradable equipment, toxicity and radioactive nature of e-waste to the human, water, soil and animals, blockage of water runoff channels, increased amount of waste and waste management disposal problem.

Economic consequences include: Substantial public spending on health care, investments in complex and expensive environment remediation technologies, loss / waste of resources that can be recycled for re-use, opportunities for recycling industries and employment lost, ozone depletion has led to unpredictable weather conditions and prolonged droughts and floods demand the use of resources which should be deployed for growth and development in other sectors. Social consequences: E-waste affects people's health (e.g. lead poisoning and cancerous mercury), growth of informal waste disposal centres in the neighbourhood, informal trade and management of e-waste and loss of appreciation for ICT (Njoroge, 2008). Despite the problem of e-waste, its proper management using environmentally sound systems presents numerous socio-economic opportunities that can stimulate entrepreneurship, employment and enhancement of livelihoods. First, Organisations and individuals that will be licensed to recycle will either create job opportunities or self-employ themselves. Experiences across the world indicate that the scale of operation for recycling e-waste is growing at viable and potentially profitable rates. Second, the refurbisher extends the functional life of electronic or electrical equipment by breaking apart the end of use equipment and selling the parts that can still be used. This process, besides creating job opportunities, saves the environment by diverting large volumes of e-waste from energy-intensive down cycling processes where the equipment is reverted to raw materials for use in manufacturing. The environmental and social benefits of refurbishing and reuse include diminished demand for new products and virgin raw materials and diminished use of landfills (Njoroge, 2008).

Thirdly, through the Producer Responsibility Organization (PRO) and take back systems those who collect e-waste and hand it over to recyclers, refurbishers and treatment plants are paid a take back fee which in away provides for livelihoods. Finally, it is a fact that e-waste contains hundreds of tonnes of various metals. These metals can be isolated, treated and made available for use in new forms. This is done by establishing metal separation facilities at landfills or e-waste deposits. This process not only creates employment but also reduces metal loading on e-waste deposit sites and hence reduces the risk of soil contamination, besides making available new metals for use (JICA, 2010). In Nairobi, dealing with materials no longer in use, particularly PCs and mobile phones, is dealt with by means of a series of social projects which handle the issue of re-use and reconditioning of equipment in the context of overcoming the digital gap, thus postponing the matter of electronic waste. The overall decision making organ is the council comprising of elected and nominated members of the county assembly and chaired by the Governor, who is also elected. Through the ministry of devolution, the county government controls the county funding and appoints the county executives, comparable to the cabinet secretaries in the central government. These officers are in-charge of the day to day running of the county affairs. According to Japan International Cooperation Agency (2010), the county government has the mandate to provide and manage basic social and physical infrastructure services to the residents. The services include but not limited to refuse and garbage collection, housing, health, education, planning and development control, urban public transport and fire services (JICA, 2010).

Until recently, it never occurred to me that one of my very favourite electronic gadgets, my mobile phone, may be a source of happiness or pain to some child somewhere else in the world. This may be regarded as a momentary case of self-reflection but the reality, once I got curious enough to search the web pages of the Internet was quite daunting not to say alarming at the least. My curious search led me to a dumpsite to the largest dumpsite in Nairobi. Dandora, as the dumpsite is known, is one of Africa's largest dumpsite with the expanse of land measuring 30 acres, filled with both electronic and solid waste from all parts of Nairobi,

its environ and across the Kenyan border. The site was intended to fill up an old quarry but increased popularity made it a mountainous dumpsite. As a measure of eliminating the growing volume of waste, the inhabitants result to burning which leaches hazardous chemicals into the soil and the Nairobi River flowing next to the site (Njoroge, 2007).

It is estimated that Dandora dumping site receives over 2000 metric tons of waste daily. Dumping at this site is unlimited which ensures that a steady stream of solid, industrial agricultural, and electronic waste is strewn all around the dump (Njoroge, 2007). A striking characteristic of the Dandora dumpsite is its secondary usage as a stable means of income for low-income inhabitants living close by. Scores of people including children sort the waste into food, recyclables, and electronics. Electronic gadgets possess components such as gold and copper that is in high demand in the electronic industry, thus, the inhabitants manually sort e waste by burning and extracting the gold and copper for subsequent sales. A study carried out by Njoroge (2007) on 328 children between the ages of 2 and 18, revealed a link between environmental pollution and public health issues. Children who lived around the dumpsite tested to high prevalence of lead in their blood. The process of waste sorting exposes both children who reside in the environment and adults who engage actively in the e-waste processing to toxins emitted from burning and decaying e-waste (Njoroge, 2007).

Statement of the Problem

While the use of electronics is steadily increasing, safe management of E-waste for sustainability is extremely essential. Inadequacy in handling e-waste poses a significant threat to both human health, economy and the environment. Previous studies have shown that poor handling of e-waste has resulted to ecological, economic and social consequences. For example, a study by Japan International Cooperation Agency (2013) revealed that it is in Nairobi County where the adverse effects of E-waste to the environment as well as health has been felt and continue to be felt. Igweta (2013), did a study on strategic evaluation of e – waste management in procurement and disposal of mobile phones, a case of mobile phone dealers in Nairobi county and found out that most of the companies and shops dealing with electronics have no policies and measures put to ensure that there is proper disposal of the e-waste tying the findings only to cost and technology as the determinants of the influx of the electronic waste, and this resulted to most e-waste being handled by the informal sector which in most cases are unskilled and lack proper knowledge and tools to handle e-waste.

A study carried out by Njoroge (2007) in Dandora dumpsite which is situated in Nairobi County on 328 children between the ages of 2 and 18, revealed a link between environmental pollution and public health issues as he found out that children who lived around the dumpsite tested to high prevalence of lead and other toxins in their blood. The study further revealed that the process of burning, sorting and recycling e-waste at the dumpsite are not safe and exposes the people who work or live around there to these dangerous toxins and heavy metals. This is replicated in many other regions around the County where these recycling is either done illegally, or in secretive manner. Most affected include the overpopulated informal settlements in Nairobi such as Mathare, Kibera, Kawangrare and Mukuru Kwa Njenga where vendors collect sort and burn e-waste to extract the metals which they later sell as raw materials to local industries.

Insufficient legislation and recycling collection systems in many countries, means that safe management of E-waste is seldom practiced, when seen on a global scale. Instead a large part of the E-waste generated in the world is sent, mostly illegally, to developing countries such as

Kenya, China, India, Nigeria and Ghana, where the E-waste may be dismantled by poor people using rudimentary methods, such as open burning in the hunt for valuable materials (UNU,2007). A large fraction of the E-waste generated in the Nairobi is treated as general municipal solid waste, and is thus incinerated in waste incineration facilities or just disposed of in dump sites or landfills without any pre-treatment (NEMA,2015).

Only a minor fraction (around 10%) is treated in recycling facilities adapted for its purpose. Even if all end-of-life treatment processes creates emissions of hazardous compounds, that may have negative impacts on human health and the environment, some processes are worse than others. Consumers/users tend to keep obsolete electronics for a while before discarding it, which may be particularly true for computers and cell phones. This fact implies that it may take time before the discarded electronics is actually going into the waste stream (CFSK, 2010). Consequently, it is evident that previous studies did not effectively address the relationship between strategic evaluation of waste and in particular electronic waste management and disposal for sustainability which could be adopted by Nairobi County Government. This study sought to fill the existing knowledge gaps by investigating the determinants of sustainability of E-waste management projects in Nairobi County.

Objectives of the Study

The main objective of this study was to establish the determinants of sustainability of E-waste management projects by Nairobi County Government. This study sought to establish the following objectives:

i. To examine how regulations influence sustainability of E-waste management in Nairobi County Government.
ii. To determine the extent to which recycling and disposal training influence sustainability of E-waste management in Nairobi County Government.
iii. To establish the influence of technology on sustainability of E-waste management in Nairobi County Government.
iv. To explore how trans-boundary movement of E-waste influence sustainability of E-waste management in Nairobi County Government.

Theoretical Review

A Theoretical Framework is a collection of interrelated ideas based on the theories. This is a reasoned set of prepositions, which are derived from the supported data. A theoretical framework accounts for or explains phenomena (Kombo and Tromp, 2006). A theory is a reasoned statement or a group of statements, which are supported by evidence, meant to explain a phenomena. While there are many theories associated with E-waste management, this study will focus on world systems theory of E-waste theory, waste management theory, social learning theory and extended producer responsibility model.

World-Systems Theory

It is no secret that industrialized nations have outsourced labour and production in order to decrease costs while concurrently increasing profit. What often goes unnoticed, however, is that corporations inside these industrialized nations have also been outsourcing waste (Anderton, Anderson, Oakes and Fraser 1994; Broswimmer 2002; Frynas 2004; Pfluger 2001; Ulph and Valentini 2001; White 2008; White, 2009): Some of the core's hazardous products, production processes, and wastes are transferred to the peripheral zones of the world-system by transnational corporations (TNCs). By suggesting that the greatest harms are committed by those who have the power to do the greatest damage, the transnational corporations and other large business organizations and the impact of their actions to

recipient jurisdictions, this theory addresses research question four which asks about the influence of trans-boundary movement of e-waste on sustainability of e-waste management projects in Nairobi County Government.

Waste Management Theory

The Theory of Waste Management, as differentiated from waste management practice, represents a more in-depth account of the domain and contains conceptual analyses of waste, the activity upon waste, and a holistic view of the functions and goals of waste management. Waste management theory suggests tools to be used to achieve set goals by environment management systems. For example, design for environment is recommended to develop such equipment assembly from which the most valuable components are easy to recover at the end of its useful life. This procedure will also help to define more practical categories and classes of waste, specify the role of waste prevention, waste minimization and waste management actions and their mutual relationships (http://www.oulu.fi/resopt/wasmin/nurminen.pdf, date accessed 26/9/2013). Environmental management systems development and policy-making activities that can through demonstrations, in the attempt to conceptualize waste management theory as an object for the basis of a new system, modelling the theoretical parts of the existing knowledge. This theory addresses the research question two which asks to what extend does recycling and disposal training influence sustainability of e-waste management in Nairobi Count Government by suggesting tools to be used in safe recycling and disposal of e-waste to achieve set goals by environment management systems such as NEMA and EMCA.

Social Learning Theory

The use of the concept of social learning stretches from psychological and pedagogical dimension based primarily on the works of Bandura (1986); to the dimension of political science and social organisation (Lave & Wenger, 1991); and then further to the problem solving dimension, where it has been increasingly advocated as a useful and necessary interactive approach in resource assessment and management. Examples of problem solving dimension are social as a means to support participatory planning in integrated water management (Pahl-Wostl et al., 2008), conservation planning and management, and participatory rural research (Rist et al., 2007);forest management, impact assessment (Webler et al., 1995; Saarikoski, 2000). Special reference is often made to the concepts of communicative rationality and communicative action, which posits that people can solve complex problems through negotiation, co-operation, deliberation and agreement about a shared definition of a situation, leading to consensus (Habermas, 1987). The implication suggested is that societies can learn to change to address socio-environmental problems (Muro & Jeffrey, 2008).This theory addresses the research question one which asks how regulations which are products of social learning theory, influence sustainability of e-waste management projects in Nairobi County Government by proposing a problem solving dimension, where it increasingly advocates for a necessary interactive approach in resource assessment and management.

Extended Producer Responsibility Model (EPR)

Extended Producer Responsibility (EPR) as a policy instrument was first proposed by Thomas Lindhqvist in 1988 and formerly introduced by the Swedish Ministry of Environment in 1990. In his words, ‘EPR is an environmental protection strategy to reach an environmental objective of a decreased total impact from a product, by making the

manufacturer of the product responsible for the entire life cycle of the product and specifically for the take back, recycling and final disposal of the product. The EPR is implemented through administrative, economics and informative instruments'. The composition of these instruments determines the precise form which an EPR takes on a particular product category and or country context (Lindhqvist, 2000) cited in (Sinha, 2004). This model addresses the research question three which asks how technology on sustainability of e-waste which are products of extended producer responsibility model, influence sustainability of e-waste management products in Nairobi County Government by suggesting that it is the responsibility of the manufacturers with consultation of the recipient countries, to enact legislation in the use of acceptable technology and technical know-how, that would ensure that the effects of e-waste are minimised if not eliminated completely.

Conceptual Framework

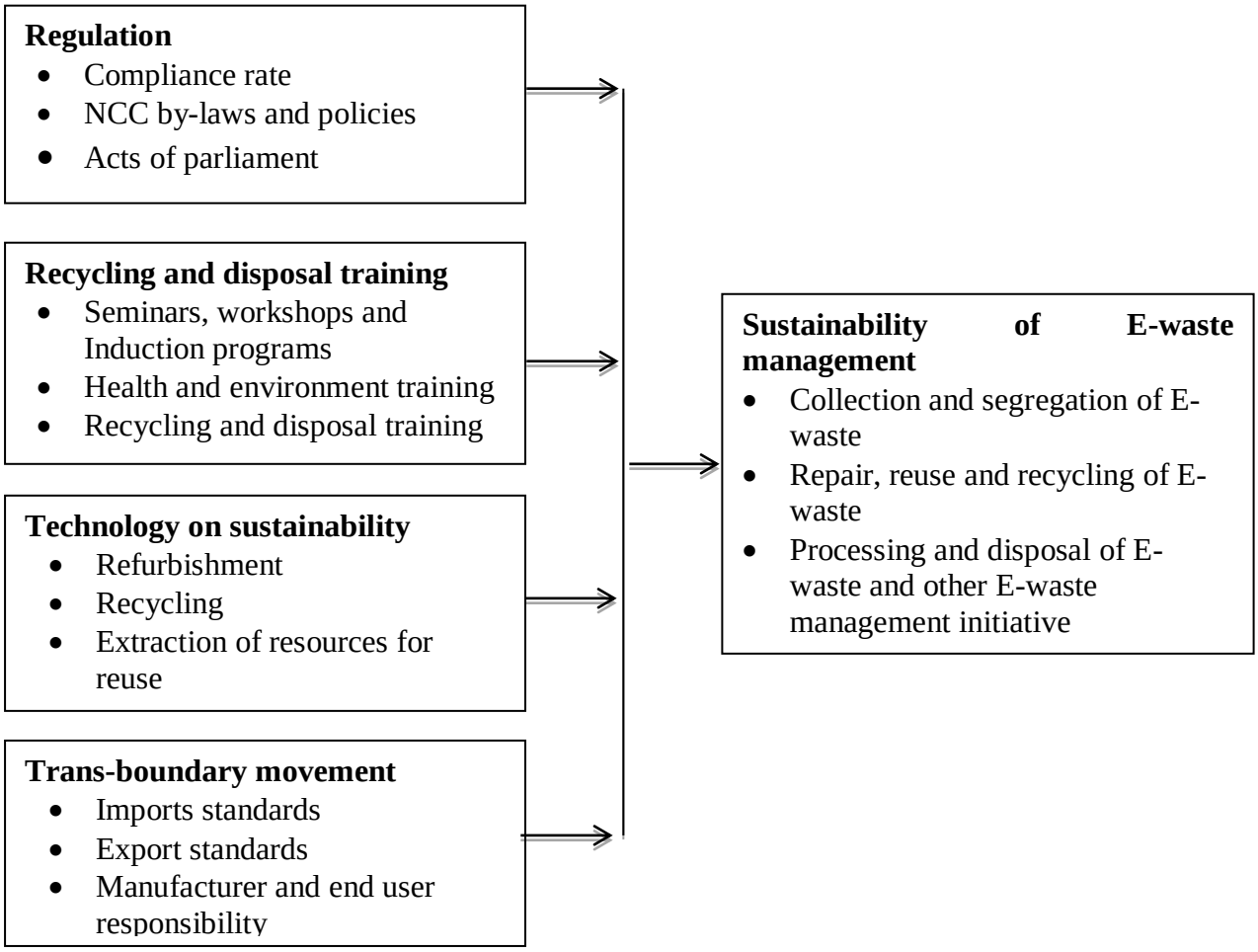

Figure 1: Conceptual Framework

Critique of The Literature

Several research works that have been done concerning electronic waste have not satisfactorily addressed the key issues which determine sustainability. According to Colin and Rainer (2009), on their study on European and Asian telecoms - their role in global

sustainable development concluded that global impact of telecommunications developments on travel and lifestyles is poised to have a significant positive effect on the environment, through changes in working practices as well as impacting on both indoor and outdoor leisure activities. However his study fell short of addressing the health issues that arise from disposal and recycling of e-waste. According to Leila and Jonathan (2010), on their study on new or recycled products: how much are consumers willing to pay, perceived functional risk as an important determinant of the price that consumers are willing to pay for products that have recycled or reused content, found that consumers will switch from a recycled product to a new product within a smaller range of price for products with high functional risk. Their emphasis was on the economic aspect of e-waste and they did not address the issues of effects of recycling e-waste on the environment as well as on the health.

Roland and Vered (2009) on economics of cell phone reuse and recycling concluded that while cell phone reuse has a healthy profit margin, handset recycling is currently a by-product of reuse. According to Wu *et al* (2008) on their assessment of toxicity potential of metallic elements in discarded electronics: A case study of mobile phones in China concluded that a single mobile phone can have a considerable toxicity to the environment, which suggests a major concern for the environmental impact of the total e-waste with a huge quantity and a heavy mass in China. This research therefore seeks to address the need to create awareness to Nairobi population by the use of jobless youths to bring to the attention of the population the value of these E-wastes especially as source of income to them, and the potential risk e-waste management pose to the environment and their health. By so doing, the research can help as a strategy of getting these wastes out of the dumping sites; improve economic well-being of the residents of Nairobi as well as managing the possible health and environmental risks caused by management of e-waste.

Research Gap

Most of the studies previously done on e-waste management concentrated on other issues other than management of e-waste for sustainability. For example, Jing Zhao Camilla, Bruun Simonsen and Louise Anine Kampp Rasmussen (2009), studied the effects of E-waste in Nigeria but failed to study how to manage these effects for sustainability. They found out that e-waste has adverse effects to both environment and human health. Rasmussen (2009), found out that Nigeria, and to extension most African countries, have not established guidelines and legal framework for management of e-waste. He concluded that e-waste is still managed just like other solid waste in most African countries, Kenya included. Antony Sije and Pamela Awuor Ochieng' (2013) studied Cell phone disposal and strategic evaluation of electronic waste management in Kenya, a case of mobile phone dealers in Kisumu County; found out that there is very training undertaken by the recyclers in the management of e-waste. They also found out that there is no awareness on the effects of transboundary boarder movement of e-waste by the recipient country, in this case Kenya. However, in most developed countries, studies on sustainability have been done.

For example, a study carried out by The University of Illinois at Urbana-Champaign Sustainable Technology Centre (2009), concentrated on Strategies for Improving the Sustainability of E-Waste Management Systems. However, the study fell short of comprehensively addressing how recycling and disposal training, regulations by the recipient countries and transboundary movement of e-waste can be incorporated in the management of e-waste for sustainability**.** Studies that have been done previously on E-waste management did not cover sustainable E-waste management in developing countries. This research will

attempt to bridge this gap by addressing the determinants of sustainability of E-waste management which include regulations, recycling and disposal training, technology and transboundary movement of e-waste in Nairobi County Government.

Research Methodology

This study adopted descriptive research design. The major purpose of descriptive research design is to provide description of the state of affairs as it exists. The design was chosen because it was appropriate to the study at hand. The target population of the study was the 325 employees of Nairobi City Council in the waste management section. The employees included those in management level, middle level and lower cadre staff.The sample size of the study was calculated using the formula below as recommended by Mugenda & Mugenda (2003): A proportion of 30% was selected using random sampling method as recommended by Mugenda and Mugenda (2003). The desired sample size thus was comprised of 135 respondents. The study used stratified sampling technique to select the employees where a respondent was picked from. Therefore, employees would be stratified into three strata is where the sample size was distributed according to Neyman allocation formula (1934). The purpose of the method was to maximize survey precision, given a fixed sample size.

Table 1: Sample size

Category of employee	No. of employees	Procedure	Sample size
Departmental heads	15	15/325*135	6
Supervisors	75	15/325*135	31
Support staff	235	235/325*135	98
Total	325		135

The study collected both primary and secondary data. Primary data was collected using questionnaires structured based on the objectives of the study. The primary data was collected using structured questionnaires as the principle data collection tool. The purpose of pilot test is to refine the questionnaire so that respondents had no problems in answering the questions and there were no problems encountered in recording the data (Sanders, Lewis & Thornhill, 2009). Descriptive statistics provided for meaningful distribution of scores using statistical measures of central tendencies, dispersion and distribution (Kothari, 2008). Data that was collected from respondents was edited, coded appropriately and analysed using the statistical package for social science (SPSS). The study also used regression analysis to determine the relationship between variables (independent and dependent variables).

The purpose of data analysis was to prepare raw data for presentation and statistical inference (Matumo, 2013).the data collected went through data preparation which involved editing, coding, classification and tabulation so that they are amendable for analysis (Marshall & Rossman, 2006). The data was analysed through descriptive statistics such as ratios, percentages and averages (means). Cropper and Schindler (2006) argued that the use of percentages was important for two reasons; first they simplify data by reducing the numbers to range from 0 to 100. Secondly, percentages translate the data to standard form with a base of 100 for relative comparisons and easier interpretation. Editing detects errors and omissions, correct them when possible, and certify that maximum data quality standards are achieved. Editing of data guaranteed that data are: accurate, consistent with the intent of the question and other information in the survey, uniformly entered and averaged to simplify coding and tabulation.

The analysed data was presented using percentages and frequency tables, bar charts and pie charts for easier understanding. The tools of analysis that were used are regression analysis,

measures of central tendency and the chi-square (Shuttleworth, 2008). The purpose of descriptive statistics was to allow for meaningful description of a distribution of scores or measurement using a few indices or statistics (Mugenda & Mugenda, 2003). Inferential statistics from the analysed data was made and this was used to answer the research questions.

Success of ICT software projects was regressed against four variables i.e. regulations, recycling and disposal training, technology on sustainability and trans-boundary e-waste movement. This hypothesised there was a direct and positive association between four independent variables- regulations, recycling and disposal training, technology on sustainability and trans-boundary e-waste movement-and sustainability of e-waste management practices.

Research Findings

Descriptive analysis, content analysis and inferential statistics were used to analyze the data and discuss the research findings.

Table 2: Response Rate

	Frequency	**Percent**
Filled and Returned	125	92.6
Unreturned	10	7.4
Total	**135**	**100**

In this study, a sample of 135 respondents were selected whereby 125 respondents filled in and returned the questionnaires making a response rate of 92.6 percent, as represented in Table 2, based on Mugenda and Mugenda (2008), the response rate was considered to excellent.

Table 3: Reliability Analysis

Scale	**Cronbach's Alpha**
Regulations	0.711
Recycling and disposal training	0.789
Technology	0.821
Trans-boundary movement of E-waste	0.832

Reliability analysis was done to determine the reliability of the questionnaire. The study used the Cronbach's Alpha. Gliem and Gliem (2003) established the Alpha value threshold at 0.7, thus forming a benchmark for the study. The Cronbach's alpha was used to determine the reliability of each objective. The findings as shown in table 4.2 indicate that regulations as an alpha of 0.711, recycling and disposal training as an alpha of 0.789, technology as an alpha of 0.821 and trans-boundary movement of E-waste an alpha of 0.832. This shows that that all the variables are reliable.

Correlation Analysis

The correlation analysis is used to analyze the association between independent and dependent variables. The study used the Pearson Moment Correlation analysis to determine the association between the study variables . The results were as shown in Table 4.

Table 4: Correlations Analysis

		Sustainability	**Regulations**	**Recycling and disposal** training	**Technology**	**Trans-boundary movement**
Sustainability	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	125				
Regulations	Pearson Correlation	.809**	1			
	Sig. (2-tailed)	.000				
	N	125	125			
Recycling and disposal training	Pearson Correlation	.786**	.386	1		
	Sig. (2-tailed)	.001	.061			
	N	125	125	125		
Technology	Pearson Correlation	.792**	.506	.511	1	
	Sig. (2-tailed)	.001	.058	.079		
	N	125	125	125	125	
Trans-boundary movement	Pearson Correlation	.814**	.296	.458	.083	1
	Sig. (2-tailed)	.000	.082	.062	.021	
	N	125	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).

The results revealed that there was a strong positive correlation between regulations and sustainability of E-waste management projects as shown by r = 0.809, statistically significant p = 0.000; there was a positive correlation between recycling and disposal training and sustainability of E-waste management projects as shown by r = 0.786, statistically significant P = 0.000; there was a positive correlation between technology and sustainability of E-waste management projects as shown by r = 0.792, statistically significant P = 0.001; there was a positive correlation between trans-boundary movement and sustainability of E-waste management projects as shown by r = 0.814, statistically significant P = 0.000. This implies that regulations, recycling and disposal training, technology, trans-boundary movement with and sustainability of E-waste management projects are related.

Regression Analysis

Model Summary

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.819[a]	0.671	0.658	0.0232

Adjusted R squared is coefficient of determination which tells us the variation in the dependent variable due to changes in the independent variable. From the findings in the table below the value of adjusted R squared was 0.658 an indication that there was variation of 65.8% on sustainability of E-waste management projects due to changes in regulations, recycling and disposal training, technology and trans-boundary movement at 95% confidence interval. This shows that a 65.8 % change in sustainability of E-waste management projects could be accounted for by changes in regulations, recycling and disposal training, technology and trans-boundary movement. R is the correlation coefficient which shows the relationship between the study variables, from the findings shown in the table below there was a strong positive relationship between the study variables as shown by 0.819.

Analysis of Variance

Table 6: Analysis of Variance

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.986	4	0.247	0.918	.038[b]
	Residual	32.214	120	0.268		
	Total	33.2	124			

From the ANOVA statistics in the table above, the processed data, which is the population parameters, had a significance level of 0% which shows that the data is ideal for making a conclusion on the population parameters as the value of significance (p-value) is less than 5%. The F calculated value was greater than the F critical value (2.447>0.918) an indication that there was a significant relationship between sustainability of E-waste management projects and regulations, recycling and disposal training, technology and trans-boundary movement. The significance value was less than 0.05 indicating goodness of fit of the model.

Coefficients

Table 7: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	0.923	0.386		2.391	0.013
Regulations	0.576	0.113	0.136	5.097	0.009
Recycling and disposal training	0.608	0.112	0.163	5.429	0.005
Technology	0.498	0.068	0.112	7.324	0.001
Trans-boundary movement	0.596	0.099	0.173	6.020	0.003

The established regression equation was;

$Y = 0.923 + 0.576\ X_1 + 0.608\ X_2 + 0.498\ X_3 + 0.596X_4$

From the above regression equation, it was revealed that holding regulations, recycling and disposal training, technology and trans-boundary movement to a constant zero, sustainability of E-waste management projects would stand at 0.923. Therefore a unit increase in

regulations would lead to an increase in sustainability of E-waste management projects by a factor of 0.576, a unit increase in recycling and disposal training would lead to increase in sustainability of E-waste management projects by factors of 0.608. A unit increase in technology would lead to an increase in sustainability of E-waste management projects by a factor of 0.498. A unit increase in trans-boundary movement would lead to an increase in sustainability of E-waste management projects by a factor of 0.596. The study further revealed holding regulations, recycling and disposal training, technology and trans-boundary movement were statistically significant to sustainability of E-waste management projects, as all the p values (sig) were less than 0.05. The study also found that there was a positive relationship between sustainability of E-waste management projects and regulations, recycling and disposal training, technology and trans-boundary movement.

Conclusions

The study found a significant relationship between regulations and sustainability of E-waste management projects. Therefore a unit increase in regulations would lead to an increase in sustainability of E-waste management projects. The study concludes that regulations would lead to an increase in sustainability of E-waste management projects. The study found a significant relationship between recycling and disposal training and sustainability of E-waste management projects. Therefore a unit increase in recycling and disposal training would lead to an increase in sustainability of E-waste management projects. The study concludes that recycling and disposal training would lead to an increase in sustainability of E-waste management projects.

The study found a significant relationship between technology and sustainability of E-waste management projects. Therefore a unit increase in technology would lead to an increase in sustainability of E-waste management projects. The study concludes that technology would lead to an increase in sustainability of E-waste management projects. The study found a significant relationship between trans-boundary movement and sustainability of E-waste management projects. Therefore a unit increase in trans-boundary movement would lead to an increase in sustainability of E-waste management projects. The study concludes that trans-boundary movement would lead to an increase in sustainability of E-waste management projects.

Recommendations

The study recommends that the government should put forth regulations that promote E-waste management. This will ensure that there are good waste management activities in the country. Hence promote sustainability of E-waste management projects. The government should encourage recycling and disposal training to educate people on issues to do with waste management. This can be done by setting up recycling institutions in the country and holding seminars to educate people about waste management. The waste management institutions should change their activities with the changing technologies. This will ensure that they adapt the best the best technologies on waste management. Hence improve the sustainability of E-waste management projects. There should be the development of an international convention dealing specifically with waste management. This will ensure that all nations have well developed waste management systems. Hence, ensure that sustainability of E-waste management projects.

Recommendations for Further Research

The aim of the study was to establish the determinants of sustainability of E-waste management projects by Nairobi County Government. The study recommends that other

studies should be carried out to examine sustainability of E-waste management project in other counties in Kenya.

References

Agyei-Mensah S, Oteng-Ababio M (2012) Perceptions of Health and Environmental Impacts of E-waste Management in Ghana. Int. Journal of Environmental Health Research. 1-18. http://dx.doi.org/10.1080/09603123.2012.667795

Babu, B. , Parande, A. K., &Basha, C., A. (2007), Electrical and electronic waste: a global environmental problem. *Waste Management & Research*, 25(4), 307-31

BAN (2005) The Digital Dump: Exporting Re-use and Abuse to Africa. Basel Action Network. October 24 2005. www.ban.org.

Blumberg, R. Cooper, D.R., Schindler, P.S. (2011) Business Research Methods 11th Edition, Irwin: McGraw-Hil

Cooper, D.R and Schindler, P.S. (2003) *Business Research Methods* (8th edn) McGraw-Hill: NewYork

DEFRA (2003). Waste and Recycling. Department of Environmental and Rural Areas. Retrived from www.defra-gov.uk, 20.07.2015, 12.00pm.

Environmental Agency, U. (2012, January). *Waste electrical and electronic equipment (WEEE)*. Retrieved January 31, 2012, from Environmental Agency: http://www.environmentagency. gov.uk/business/topics/waste/32084.aspx

GoK, (2012). National Environmental Management Authority (NEMA) Records, 2015. (Unpublished).

Igweta, K (2013), *strategic evaluation of e- waste management in procurement and disposal of mobile phones.* Unpublished document.

JICA-Japan International Cooperation Agency (2010). The study of Solid Waste Management in Nairobi City in the Republic of Kenya: Interim report. CTI n .

Mauk, J., & Metz, J. (2011). *Inventing Arguments.* Boston: Wadsworth Cengage Learning.

Mugenda, M. O., Mugenda, A. (1999). *Research Methods: Qualitative and Quantitative Approaches*. African Centre for Technology Studies. Nairobi, Kenya.

Mureithi W, Wanjira A, Schulep M, (2007), *E waste in Kenya: Baseline Assessment*, School of Computing informatics, University of Nairobi

Muro, M. & Jeffrey, P. (2008). A Critical Review of the Theory and Application of Social Learning in Participatory Natural Resource Management Process. Journal of Environment Planning and Mnagement, 51 (3):325-344.

Mwendwa, S., (2006). *Municipal solid waste management strategy selection model: Jomo Kenyatta University of Agriculture and Technology*, Kenya

National Environment Management Authority, (2009), *E waste management in Kenya,* Annual report.

Njoroge, K. G. (2007). *Environmental Pollution and Impacts on Public Health: Implications \of the Dandora Municipal Dumping Site in Nairobi, Kenya.* Korogocho: In \cooperation with United Nations Environment Programme and the St. John Catholic Church.

Puckett, J., Byster, L., Westervelt, S., Gutierrez, R., Davis, S., Hussain, A., et al. (2002). *Exporting Harm: The High-Tech Trashing of Asia.* Seattle: The Basel Action Network (BAN) Silicon Valley Toxics Coalition (SVTC).

United Nations University (UNU). (2007). *2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE). Final Report.* Germany: United Nations University.

United Nations Environment Programme (UNEP) (2010), Available at www.unep.org